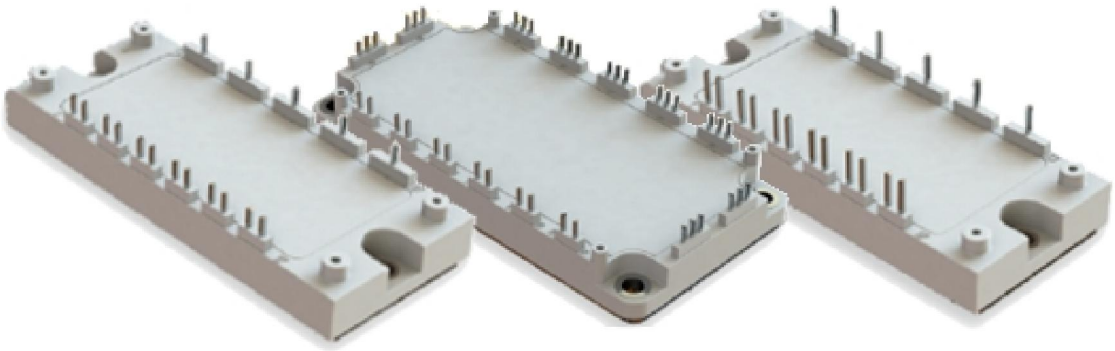
TRANSISTOR MODULES IGBT
IN DESIGN VERSIONS S1, S2, S3

USER'S MANUAL



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CONTENTS

1. APPLICATION AND PRODUCED MODULES

IGBT-modules in design versions «S1», «S2», «S3» are assemblies IGBT-transistors and FRD-diodes are intended to commutate of power loads as part of converters with a maximum peak voltage 1200 V and DC up to 150 A. IGBT-modules are presented with the following versions:

M13A-S1 – three-phase inverter in housing «S1» (see Fig.6.1). The module is produced with a number of maximum DC 25, 50 A.

M13B-S1 – H-bridge in housing «S1» (see Fig.6.1). The modules is produced with a number of maximum DC 25, 50 A.

M13A-S2 – three-phase inverter in housing «S2» (see Fig.6.2). The module is produced with a number maximum DC 25, 50 A.

M13B-S2 – H-bridge in housing «S2» (see Fig.6.2). The module is produced with a number of maximum DC 25, 50 A.

M13A-S3 – three-phase inverter in housing «S3» (see Fig.6.3). The module is produced with a number of maximum DC 50, 75, 100 A.

M13B-S3 – H-bridge in housing «S3» (see Fig.6.3). The module is produced with a number of maximum DC 100,150 A.

In dependence on the current, the voltage and the version the modules are produced in designs specified in Table 1.1. The modules are produced only in the versions where when crossing the module type line and the current column is specified the overall dimension corresponding to the version.

Table 1.1 – Produced IGBT-modules and corresponding to them overall dimensions

Module type	Current, A				
	25	**50**	**75**	**100**	**150**
M13A-S1	Fig.6.1	Fig.6.1			
M13B-S1	Fig.6.1	Fig.6.1			
M13A-S2	Fig.6.2	Fig.6.2			
M13B-S2	Fig.6.2	Fig.6.2			
M13A-S3		Fig.6.3	Fig.6.3	Fig.6.3	
M13B-S3				Fig.6.3	Fig.6.3

On Figure 1.1 is shown modules name explanation.

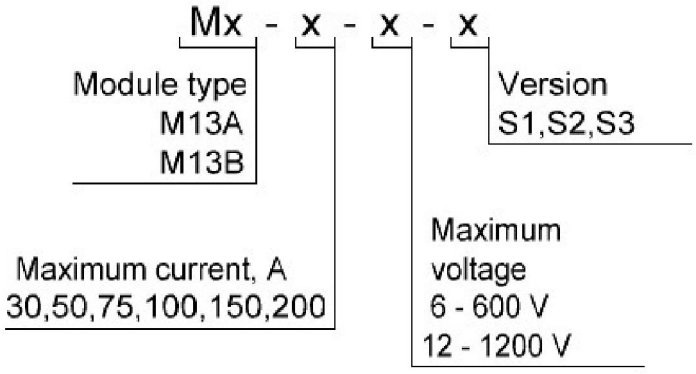

Figure 1.1 – Modules name explanation

For example, a module M13A-100-12-S3: three-phase inverter with maximum collector-emitter permissible voltage 1200 V, maximum permissible DC 100 A in version «S3».

The modules are analogues of power modules produced by «Infineon» in accordance with Tables 1.2 – 1.4.

Table 1.2 – Conformity modules in housing «S1»

Class, V	Current, A	Housing	Infineon	"Electrum AV", CJSC
Three-phase inverter (SixPACK)				
1200	25	S1	BSM25GD120DN2E3224	M13A-25-12-S1
1200	50	S1	BSM50GD120DN2	M13A-50-12-S1
H-bridge (FourPACK)				
1200	25	S1		M13B-25-12-S1
1200	50	S1		M13B-50-12-S1

Table 1.3 – Conformity modules in housing «S2»

Class, V	Current, A	Housing	Infineon	"Electrum AV", CJSC
Three-phase inverter (SixPACK)				
1200	25	S2	BSM25GD120DN2	M13A-25-12-S2
1200	50	S2	BSM50GD120DN2E3226	M13A-50-12-S2
H-bridge (FourPACK)				
1200	25	S2		M13B-100-12-S3
1200	50	S2		M13B-150-12-S3

Table 1.4 – Conformity modules in housing «S3»

Class, V	Current, A	Housing	Infineon	"Electrum AV", CJSC
Three-phase inverter (SixPACK)				
1200	50	S3	BSM50GD120DN2G	M13A-50-12-S3
1200	75	S3	BSM75GD120DN2	M13A-75-12-S3
1200	100	S3	BSM100GD120DN2	M13A-100-12-S3
H-bridge (FourPACK)				
1200	100	S3		M13B-100-12-S3
1200	150	S3		M13B-150-12-S3

2. GENERAL DESCRIPTION

In dependence on the module type the electrical circuits of the modules are different; on Figures 2.1 - 2.4 are represented possible variants of the modules circuits.

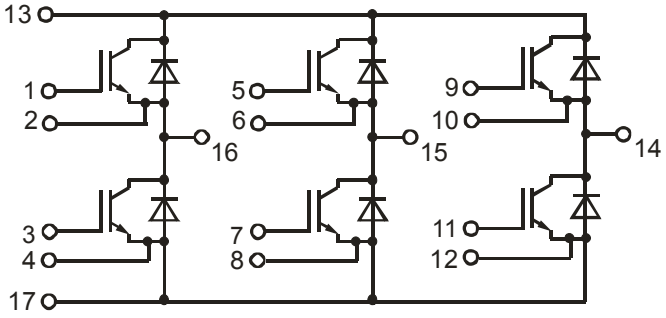

Figure 2.1 – Electrical circuit M13A of versions S1,S2

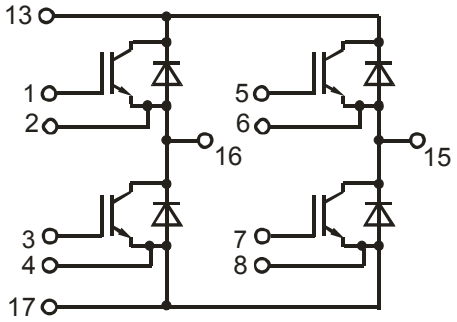

Figure 2.2 – Electrical circuit M13B of versions S1,S2

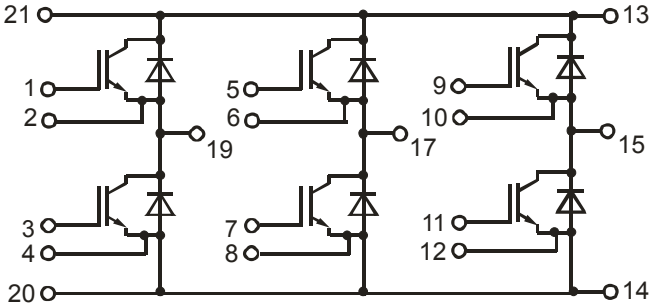

Figure 2.3 – Electrical circuit of M13A of version S3

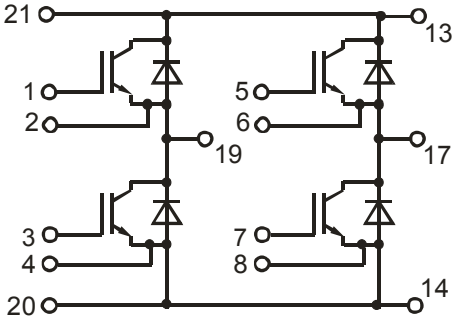

Figure 2.4 – Electrical circuit M13B исполнения S3

Attention! When transporting gate and emitter must be short-circuited!

3. BASIC PARAMETERS

Basic electrical parameters and maximum permissible parameters at temperature 25^0C are shown in Table 3.1.

Table 3.1 – Basic and maximum permissible modules parameters

Parameter name, Unit	Symbol	Module maximum DC, A				
		25	50	75	100	150
Basic characteristics						
Collector-emitter breakdown (min), V	$V_{(BR)CES}$	1200				
Power circuit direct voltage (max), V	V_{DV}	650				
Power circuit DC (max), A	I_{DC}	25	50	75	100	150
Junction-transistor housing thermal resistance (max), ºC/W	$R_{T(j\text{-}c)\ VT}$	0.45	0.4	0.35	0.3	0.2
Junction-diode housing thermal resistance (max), ºC/W	$R_{T(j\text{-}c)\ VD}$	0.7	0.7	0.65	0.6	0.4
Power dissipation (max), W	P_D	300	300	360	420	625
Circuit-isolation electrical strength (DC), V	V_{ISOL}	4000				
Static characteristics						
Gate-emitter threshold voltage, V	$V_{GE\ (th)}$	3…6	4.5…6.5	4.5…6.5	4.5…6.5	4.5…6.5
Gate leakage current (max), nA	I_{GES}	±200	±500	±500	±500	±500
Collector-emitter saturation voltage (typical), V	$V_{CE(on)}$	1.7	1.7	1.7	1.7	1.7
Collector-emitter saturation voltage (max), V	$V_{CE(on)}$	2.1	2.2	2.2	2.2	2.2
Collector leakage current (max), μA	I_{CES}	200	100	100	100	100
Dynamic characteristics						
Input capacitance (typical), pF	C_{ies}	3500	4000	4000	4500	6000
Output capacitance (typical), pF	C_{oes}	150	250	250	300	450
Transfer capacitance (typical), pF	C_{res}	100	200	200	220	300
Switch-on delay time (max), ns	$t_{d(on)}$	50	150	150	150	200
Rise time (max), ns	t_r	50	80	80	80	200
Switch-off delay time (max), ns	$t_{d(off)}$	400	700	700	700	700
Fall time (max), ns	t_f	100	150	150	150	150
Switch-on loss energy (max), mJ	E_{ON}	3	5	5	5.5	18
Switch-off loss energy (max), mJ	E_{OFF}	2	7	7	7.6	24
Gate common charge (typical), nC	Q_G	250	400	500	600	800
Reverse diode characteristics						
Direct voltage fall (typical), V	v_F	2.0	2.1	2.1	2.1	2.1
Direct diode current (max), A	I_F	30	50	75	100	150
Pulse diode current at t_{pul} = 1 ms (max), A	I_{FM}	90	150	225	300	450
Reverse recovery current (typical), A	I_{RR}	30	50	50	75	125
Recovery time (typical), ns	t_{RR}	200	200	200	200	250
Maximum permissible modes						
Collector-emitter voltage (max), V	V_{CES}	1200				
Gate-emitter voltage (max), V	V_{GE}	±20				
Direct collector current at T_{amb} = 25 °C (max), A	I_C	35	70	100	120	175
Direct collector current at T_{amb} = 100 °C (max), A	I_C	25	50	75	100	150
Pulse collector current at t_{pul} = 1 ms (max), A	I_{CM}	75	150	225	300	450
Junction temperature (max), ºC	Tj	150				

4. INSTRUCTIONS FOR USE

General requirements

It is recommended to operate the module at operating value of average current not more than 80% from the mentioned in the name of the module and junction temperature not more than (70÷80)% from maximum one.

It is not allowed operating the modules in modes at simultaneous impacting two or more maximum permissible parameters' values.

In the electrical circuit of the equipment with use of the modules should be provided a fast-recovery protection against overloads, SCs and commutating overloads.

Module mounting

The module is mounted in the equipment to cooler (chassis, application housing, metal plates, etc.) in any orientation with screws M5 or M6 with torque (5±0.5) N·m, with obligatory installation of flat and spring washers. The module should be located in such a way to protect it against additional heat from neighboring elements. The planes of cooler ribs should be oriented in the direction of air flow.

The contact area of the cooler should have roughness not more than 2.5 μm and flatness tolerance– not more than 30 μm. Cooler surface should not have any rough edges, honeycombs. There should not be extraneous particles between the module and cooler. To improve the heat balance the module installation to mounting area or cooler should be carried out by instrumentality of heat conducting pastes or having similar heat conducting properties.

When mounting, you should provide uniform pressure of module housing to cooler. For this purpose you should tighten all screws uniform in 2 – 4 motions by turns: first, located on one diagonal, then on the other one. Disassembling the module the screw tightening should be done the reverse order.

Not earlier than in 3 hours after mounting the screws should be rotated to the end, keeping the prescribed torque, because the part of heat conducting paste under pressure will outflow and the fastening can fail.

You can install the several modules without additional insolating spacer to one cooler, on condition that voltage between outputs of different modules will not exceed the minimum value of isolation breakdown voltage of each of them or when cooler is grounded.

Connection to module

Connecting of the electrical wires and cables to the power and controlled modules contacts is carried out by soldering. Permissible number of module outputs' re-soldering during electronic (assembly) operations is three. Outputs soldering should be performed at temperature not higher than 235 °C. Soldering duration is not longer than 3 s.

When mounting and operating it is necessary to make protection measures against static electricity impact; on mounting the personnel should use the ground bands and grounded low-voltage soldering irons with transformer supply.

Operating requirements

Module should be used under mechanical loads in accordance with Table 4.1.

Table 4.1 – Mechanical loads impact

External exposure factor	External exposure factor value
Sinusoidal vibration: - acceleration, m/s^2 (g); - frequency, Hz	 150 (15) 0.5 - 100
Multiple-acting mechanic shock: - peak shock acceleration, m/s^2 (g); - shock acceleration duration, ms	 40 (4) 50
Linear acceleration, m/s^2 (g)	5000 (500)

The module should be used under climatic loads in accordance with Table 4.2.

Table 4.2 – Climatic loads impact

Climatic factor	Climatic factor value
Reduced ambient temperature: - operating, °C; - maximum, °C	 - 40 - 45
High ambient temperature: - operating, °C; - maximum, °C	 + 85 + 100
Relative humidity at temperature 35 °C without moisture condensation, %, max	98

Safety requirements

1. Working with the module should only be performed by qualified personnel.
2. Do not touch the power terminals of the module when applying a voltage.
3. Do not connect or disconnect the wires and connectors while the power to the circuit module is applying voltage.
4. Don't touch the module's radiator if it is not grounded and it's applied a voltage.
5. Don't touch the cooler and the module's housing in time its operation thereby their temperature can be very high.
6. Immediately turn off the power supply of the module if it discharges smoke, odor or abnormal noises, check if the module correctly connected.
7. It is not allowed penetrating water and other liquids to the module.

5. RELIABILITY REQUIREMENTS

The manufacturer guarantees the quality of the module all the requirements of the user's manual if the consumer observes terms and conditions of storage, installation and operation, as well as guidance on the application specified in the user's manual.

Operating warranty is 2 years from the acceptance date, in the case of requalification – from the date of the requalification.

Reliability probability of the module for 25000 hours must be at least 0.95.

Gamma percentage life ($T\gamma$) of module at $\gamma = 90\%$ in typical operation conditions should not be less than 50 000 hours within lifetime.

Gamma-percent service life of the modules, subject to cumulative operating time is not more than gamma-percent life, not less than10 years, at $\gamma = 90$ %.

Gamma-percent storageability time of the modules, at $\gamma = 90$ % – 10 years.

6. OVERALL AND CONNECTING DIMENSIONS

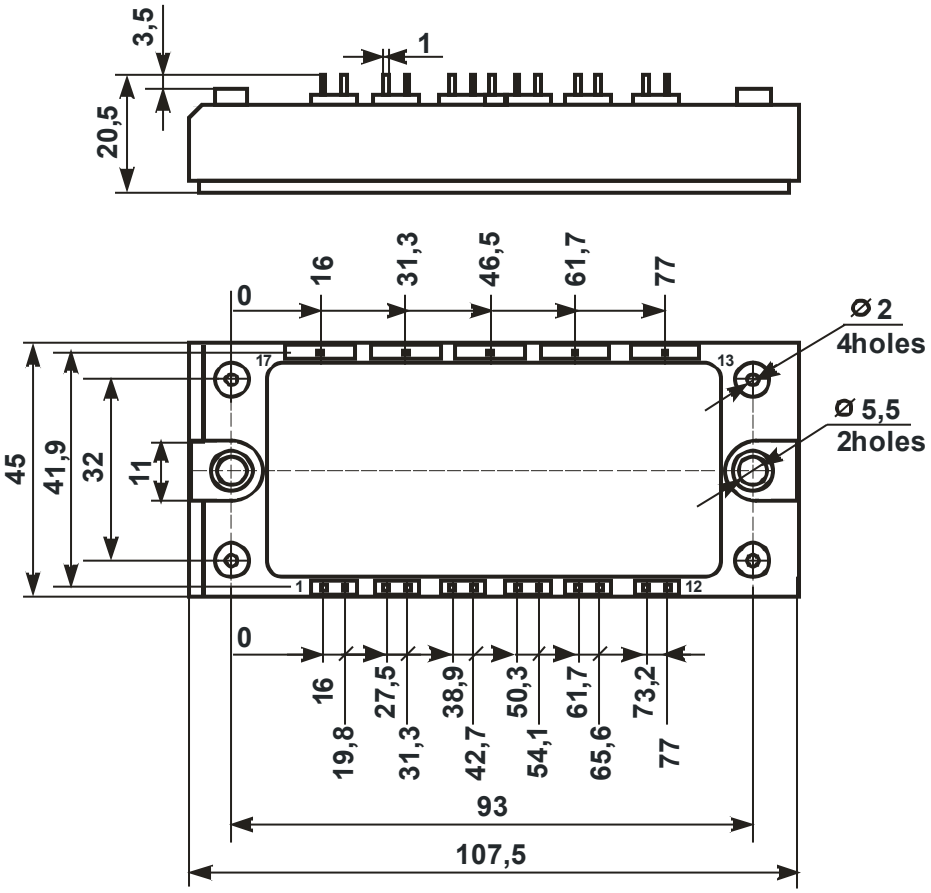

Figure 6.1 – Modules overall dimensions of version «S1»

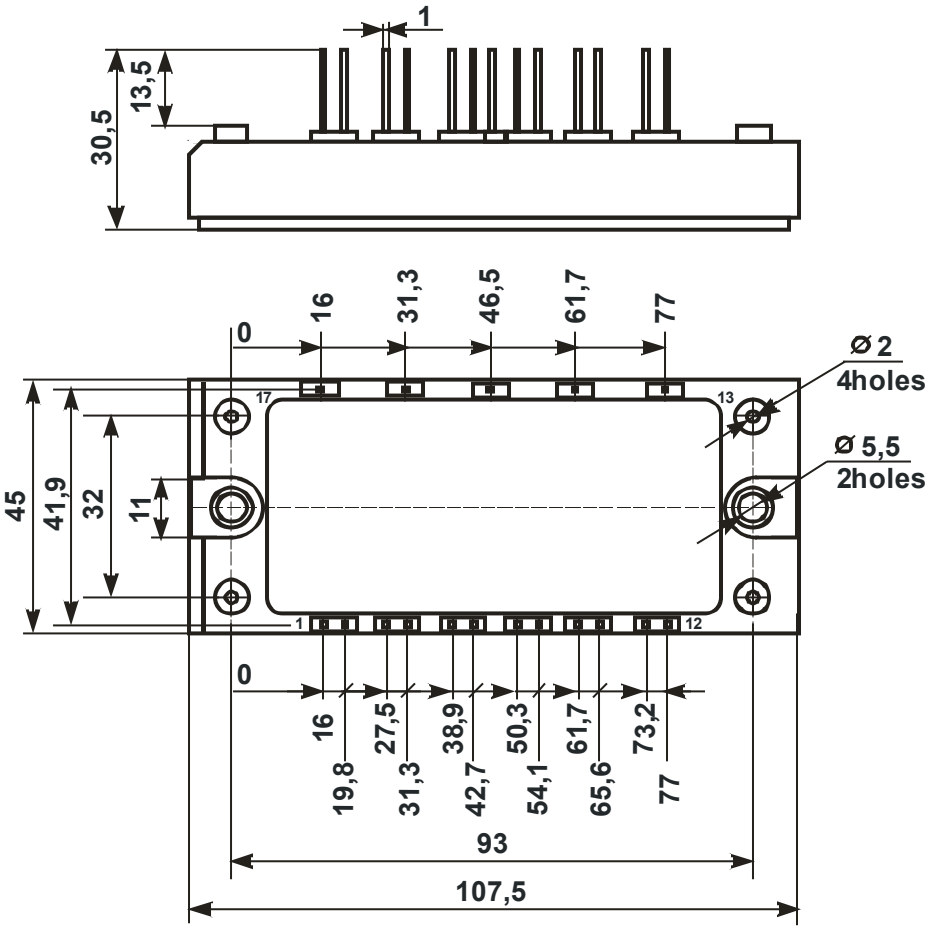

Figure 6.2 – Modules overall dimensions of version «S2»

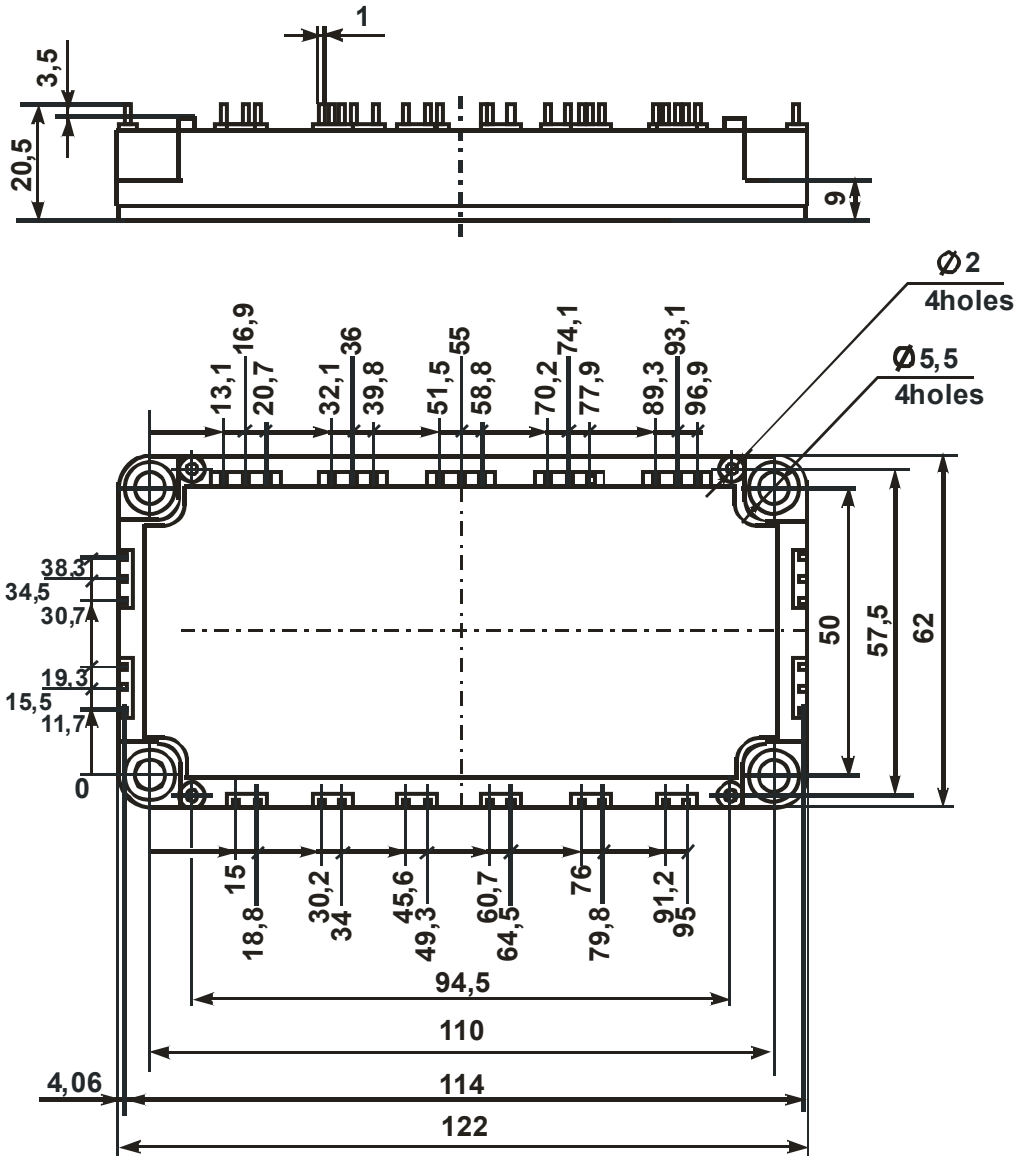

Figure 6.3 – Modules overall dimensions of version «S3»

Precious metals are not contained.

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